AN

INQUIRY

INTO

THE ACTION OF MERCURY

ON THE

LIVING BODY.

BY JOSEPH SWAN.

> Sed assiduitate quotidianâ et consuetudine oculorum assuescunt animi; neque admirantur, neque requirunt rationes earum rerum, quas semper vident: perinde, quasi novitas nos magis, quam magnitudo rerum, debeat ad exquirendas causas excitare.
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> CICERO *de Natura Deorum*, lib. 2.

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PREFACE.

THIS is a selection from a work which the Author published many years ago; and such further observations have been added as his experience has suggested. It has been revised and re-printed, for the sake of keeping up an inquiry into the probable action of medicines on the constitution generally, and on specific structures, and to determine whether they are really removing the natural disease, and not producing an equally hazardous or a more baneful artificial one.

In relating the appearances presented on dissection after the experiments, the Author has retained the expression, "inflamed," or "very much inflamed," with reference to the sympathetic nerve or its ganglia; but he thinks it would be more proper to state that they were "red," or "very red," as denoting a state of less or greater irritation approaching to that of inflammation.

AN INQUIRY

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THE ACTION OF MERCURY.

THERE is no active medicine whose employment is more general, and whose operations are less understood, than those of mercury; therefore, when it is considered how many suffer from its abuse, it seems to be a matter of great moment to ascertain the various changes it produces, some of which are so severe as to allow the system to recover very slowly, or never to return to its former condition, and in a few instances to induce sudden death.

As its effects increase according to the quantity used, it may be presumed either that it is absorbed and accumulates in the body, or that it produces a material change in some very important organs, which are capable of influencing the system generally. Two things only lead to a supposition that it is absorbed and taken into the system, as the peculiar taste frequently experienced in its use, and the changes in silver worn about the body. The peculiar taste experienced in its use may be often noticed in disorders of the chylo-poietic viscera, or the exposure of the mouth to an impure atmosphere. Nevertheless, in the various experiments Mr. Hunter made on himself, both by taking it internally, rubbing it on the skin, and working crude mercury about in his mouth, he believed that in all of them it was brought to a state of solution. If mercury could be collected on silver worn about the body, when it has not been used externally, but only taken by the mouth, it might be presumed that it had previously penetrated the minutest vessels; but when it has been used by friction, no dependence can be placed on any such appearances, as some portion of the ointment may have come in contact with the silver, and have tarnished it.

In proof of the absorption of mercury, it has been stated that it has been found in various parts of the body after death. It appears very improbable that it should be taken into the circulation by the absorbents, and deposited by the terminal arteries, in its metallic form, for it must always have passed through the lungs; and in experiments with mercurial preparations introduced into the blood, inflammation of the lungs was invariably produced; and in those with crude mercury very numerous abscesses in the same organs. Nevertheless, as this hypothesis is still maintained, a few further observations will be offered.

It will not be denied that it has been found in the bones and even in the soft parts. When it has been swallowed in its crude state and not evacuated from the bowels before death, on the separation of the flesh by putrefaction, some of it may have insinuated itself into the bones of the most open texture. It is not impossible that even in the living body, it may have made its way from the intestines into other parts. In two instances, a large quantity was given in obstruction of the bowels; in the one a great portion of it was found in the enlarged vermiform appendage of the cœcum; in the other, the whole of it was collected into one place near the obstruction, and might have escaped into various other parts, and insinuated itself wherever gravitation directed it. It is frequently used in anatomical pursuits; and globules may be found in preparations at a very distant period, when it has been forgotten that it had ever been employed.

It is not probable that it can collect in any part of the body without acting as an extraneous substance, either by producing inflammation and suppuration, or by becoming encysted. M. Gaspard* introduced quicksilver into the crural artery of a dog; swelling, and great pain of the lower extremity, were induced, and death in sixty hours. Numerous abscesses were found containing quicksilver; it flowed out on making incisions into the skin, cellular membrane, and muscles; the small arteries were freely injected, but none had passed through the capillary arteries into the veins, and there was not any in the secretions, or in any other part about the limb.

In July, 1753,† a young man, in making an experiment with a glass tube full of quicksilver, broke it, and to prevent the loss of the liquid, which ran out with force, he placed the thumb on the broken end, the point of which entered about the middle of the last phalanx. A small wound was the consequence, to which the patient paid very little attention; he applied a plaster, and it appeared reunited in six days; but at that time the thumb became tense, and pain and fever, and every symptom of constitutional irritation, supervened. After considerable suffering for many months, such an incision was made as allowed the quicksilver to pass out freely, and the patient got quite well. No mercurial action during the whole period ever appeared.

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* Mémoire sur le Mercure dans le Journal de Physiologie, tome 1.

† Mémoires de l'Académie de Chirurgie, tome 3.

Crude mercury, when swallowed, generally passes off without producing any specific effect. Mead* says, "I remember two accidents of this kind, and one of them proved fatal, in which when small quantities had been given for many days together, a violent salivation ensued, more than two months after the use of it had been left off. And not long since, I saw a young lady, who, having swallowed about six drachms every morning three successive days, was salivated three weeks. The flux then ceased, but returned after six months, and held a month; and once more came on in the same manner two months after. The breath was each time strongly affected, as is usual in mercurial spittings."

On considering the effects of various preparations of mercury, it appeared that even if they become absorbed and enter the circulation, or produce their effect by contact with living parts, they affect the nervous system. This opinion was strengthened in the first instance by considering the appearances presented in dissecting the sympathetic nerve of a person who seemed to have been under the influence of mercury; for both sides of the face were much swollen; the salivary and absorbent glands were much enlarged; the teeth were loose, and there was a separation of the gums. The ganglia and branches of the sympathetic nerve were found larger than in any previous dissection; there was also an increased size of the par vagum. The other nerves were not enlarged. There was an encysted tumour in the liver, about the size of a pigeon's egg, and the substance of the liver was streaked with red in a peculiar manner, which appearance seemed to be the effect of inflammation. On finding this state of the sympathetic nerve and par vagum, it appeared desirable to make a further inquiry by experiments on animals.

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* On Poisons, page 196.

EXPERIMENT I.

A moderate-sized, full-grown dog had five grains of submuriate of mercury given her on the 2nd of July, 1822, in the morning, and the same quantity at night. On the 3rd, she took the same quantity. On the 4th, she took four grains in the morning, and the same quantity in the evening, and a grain of opium was added to each dose, to prevent its purging her too much. 5th. She took three grains in the morning, and the same quantity at night, without opium. 6th. She took four grains in the morning; in the evening she took four grains more, and to this dose a grain of opium was added. In the morning a large ulcer, having the characters of a chancre, was perceived on each side of the upper lip. 7th. She took four grains, and one grain of opium. She appeared to swallow with difficulty. 8th. She took four grains without opium. Other ulcers were perceived about the gums. 9th. She took four grains, with one grain of opium. She would not touch either milk or water. About four o'clock P. M., bloody saliva kept constantly running from the mouth;

at six P. M. she could not be roused, and appeared to be dying. 10th. In the morning, she appeared better, and was on her legs. In the evening she lay in the same state as on the preceding evening, and in the morning she was found dead. She did not eat anything after the first two or three days, but generally appeared to be excessively thirsty. The use of the legs, and especially of the hinder ones, appeared diminished.

EXAMINATION.

There were several small ulcerations on the inside of the cheeks, and many of the teeth were loose. The brain appeared sound, but its membranes were too full of vessels, much more so than in health. The spinal chord appeared soft, but otherwise neither it nor the membranes inclosing it were unhealthy. The stomach and all the thoracic and abdominal viscera were sound. There were some reddish spots on the villous coat of the small intestines, and the mucous membrane of the large intestines was very red, having the appearance of being affected by chronic inflammation.

The ganglia of the sympathetic nerves were very vascular, and likewise the par vagum, and all the nerves were more vascular than in a state of health, and on one of the sciatic nerves there was a spot of ecchymosis. The aorta, on its outside, and especially about its arch, was unusually vascular.

EXPERIMENT II.

A large healthy dog of about a year old, on the 12th of July, 1822, took three grains of submuriate of mercury. 13th. She had three grains more. She ate very well, and did not appear affected by the mercury. 14th. She took three grains more. She would eat very little, was thirsty, and unwilling to move. 15th. She took three grains more. Her gums were red, but in other respects the symptoms were the same. 16th. She took three grains more. There were ulcerations just where the cheeks and gums join. In other respects the symptoms were the same. 17th. She took three grains more, and after this no more was given.

19th. She would not take either milk or water, and lay perfectly quiet. 20th. The sores of the mouth have increased. She has purged every day. At first the stools were black, but for the last two days have been of a dark orange colour. 21st. She has taken some water in the night. The sores in the mouth are more extensive, but do not appear so deep. She never stirs. 23rd. The sores in the mouth are larger. In other respects she is the same. 27th. She died at 7 P.M., after being convulsed for several hours. She had not eaten anything since the 14th, and had drunk very little for several days. Within the last few days the stools were of a chocolate colour, and occasionally contained a few drops of blood.

EXAMINATION.

The body was examined nine hours after death. On dissecting off the skin, the whole of its inner surface was found to be very vascular. On opening the abdomen, the viscera had a sound appearance. The villous coat of the small intestines had a few red spots upon it; and the mucous coat of the large intestines was red, but not near so much so as in the former experiment. The thoracic viscera appeared sound; but the external coat of the aorta was very vascular, as in the preceding experiment. There were several large ulcers in the mouth, and the membrane covering the whole of the throat was too red. The par vagum was inflamed, and especially at its superior part; it was then not so red, and then again, where it communicates with the inferior cervical ganglion, it was very red. All the ganglia of the sympathetic nerves were inflamed, and likewise portions of their nerves, and one portion of the nerve, especially before it formed the left semilunar ganglion, was much inflamed and thickened, and there was a red substance about it like the coagulable lymph effused by nerve when it has been wounded. The pia mater of the brain was too full of vessels, but the brain was sound. On opening the spinal canal there was a little fluid in the inferior part of the sheath, formed by the dura mater, but the membranes and chord were sound: indeed, if any deviation existed from the healthy state, the pia mater was a little too vascular, and the chord rather softer, but there was no material change. The sciatic nerves were more vascular than usual, but this appearance was very much increased near the ischiatic notch. The axillary plexus was very vascular, but this appearance existed in a very trifling degree in the nerves lower down the leg. The ganglia of several of the spinal nerves were examined fifty-six hours after death, and though the animal had been kept in water since the first examination, these were still found so full of vessels as to appear to have partaken of the inflammatory action.

With a view of ascertaining how mercurial preparations act when introduced into the veins, the following experiments were made :—

EXPERIMENT III.

January 28, 1823, at two P.M., ten grains of submuriate of mercury mixed in an ounce of water were injected into the right jugular vein of a spaniel bitch. About a quarter of an hour after, she appeared to wish to lie still, and had tremblings of the whole body. At a quarter before four, she breathed with difficulty, and would neither eat nor drink. At five, the difficulty of breathing was very great, and continued so at nine; and in the course of the night she died.

EXAMINATION.

The lungs presented numerous purple patches, and their substance was very firm, whilst here and there a vesicle was observed on their surface. The heart appeared sound. The peritoneum appeared inflamed. The villous coat of the stomach and small intestines was very red, and covered with bloody mucus. In the upper portion of the small intestines there were several ulcerated patches. In the lower portion there were only a few red spots. The rectum was very red, and covered with bloody mucus.

All the ganglia of the sympathetic nerves were very red, and especially the inferior cervical. The par vagum was more red than natural.

The membranes of the brain were very vascular, and the brain itself was rather too vascular. The spinal chord and its ganglia appeared healthy.

To see whether the appearances just described were produced by the submuriate of mercury as an extraneous substance merely, the following experiment was made:—

EXPERIMENT IV.

January 30th, 1823, at half-past twelve at noon, ten grains of prepared chalk, mixed with an ounce of water, were injected into the right jugular vein of a large dog, not quite six months old. He soon after ate some meat with a good appetite. At three P.M. he ate again, and appeared quite well. 31st. He ate heartily, and appeared quite well.

EXPERIMENT V.

January 31st, 1823, at half-past nine A.M., ten grains of submuriate of mercury, mixed in an ounce of water, were injected into the left jugular vein of the dog who was the subject of the former experiment. He vomited soon after, and appeared to be in pain. At one P.M. he breathed with great difficulty. About five he ate some meat, and drank water. He continued to breathe with difficulty, and was found dead at half-past eight P.M.

EXAMINATION.

This took place at eight the next morning. The superior dorsal ganglion of each sympathetic nerve was much inflamed, and likewise all the other ganglia in the chest. The left semilunar ganglion was much inflamed, but there was very little redness in the right, or any of the other ganglia in the abdomen. The superior cervical ganglia were much inflamed. The right par vagum, just where it communicates with the inferior cervical ganglion, was much inflamed. The cardiac nerves were red. The nerves of the axillary plexus were redder than natural, much more so than the sciatic.

The membranes of the brain were very vascular. There was a large mercurial ulcer on the inside of the left cheek. The lungs were inflamed, and solid. The heart was sound. The peritoneum was not inflamed. Neither the villous coat of the stomach, nor small intestines, showed the same redness as in the preceding experiment; but the inner coat of the large intestines was very red, and covered with bloody mucus. The spleen had a peculiar appearance, being studded with white spots.

EXPERIMENT VI.

April 9th, 1823, at half-past seven A.M., I injected one drachm of mercury with chalk, mixed with two ounces of water into the left jugular vein of a very large dog. He did not at first appear much affected; still, however, difficulty of breathing came on, and he died at half-past twelve at noon.

EXAMINATION.

This took place about an hour-and-a-half after. All the ganglia of the sympathetic nerves were inflamed, but the superior cervical, the superior dorsal, and the semilunar were so in the greatest degree. The par vagum, likewise the axillary plexus, and sciatic nerves, and the brain and spinal chord, and their membranes, and the ganglia of the spinal nerves, were more vascular than natural.

The lungs were inflamed and solid, and not so purple as when the submuriate and oxymuriate of mercury have been used. The lining of the trachea was very vascular. There was much fluid in the chest, which, on being removed, had in some degree a gelatinous appearance. The posterior mediastinum was loaded with the same fluid. The thoracic duct was full of lymph, which had no taste, and did not tarnish silver in the least. The peritoneum appeared inflamed, the villous coat of the stomach and small intestines was very vascular. The inner coat of the rectum was red, but not in a very great degree. The inner coat of the bladder was very vascular.

EXPERIMENT VII.

March 15th, 1823, at half-past seven A.M., one grain of oxymuriate of mercury, dissolved in an ounce of water, was injected into the left jugular vein of a full-grown dog of moderate size. He breathed with difficulty, and purged several times, and vomited. He died at twelve at noon.

EXAMINATION.

This took place two hours after death. All the ganglia of the sympathetic nerves were inflamed. The par vagum was more red than usual at the places where it communicates with the sympathetic nerve. The brain and spinal chord were rather more vascular than usual. The ganglia, formed by the fifth pair of nerves just before they leave the cranium, were red, as if slightly inflamed, and the ganglia of the spinal nerves were red in the same degree, but they were not near so much so as the ganglia of the sympathetic nerves.

There was much fluid in each cavity of the chest. The cellular membrane in the posterior mediastinum was loaded with serum. The inferior lobe of each lung was inflamed, thickened, and purple, and several vesicles were observed on that of the right side. The other lobes were hardly altered, either in appearance or to the touch; and the superior lobe of the left lung was not altered in the least.

The villous coat of the stomach and intestines was much inflamed, and especially the superior part of the small intestines, and the rectum. The whole peritoneum was inflamed. The mucous membrane of the bladder was inflamed.

EXPERIMENT VIII.

March 21st, 1823, at a quarter before eight A.M., one grain of oxymuriate of mercury, dissolved in an ounce of water, was injected into the left jugular vein of a large dog, eight months old. At a quarter past eleven she had purged several times, and pure blood was in her stools. In the evening she ate with an appetite. 22nd. She appears to have vomited what she ate yesterday. She is thirsty; has purged much, and is upon the whole much the same as yesterday. 23rd. She is much the same as yesterday. In the afternoon she became much worse. She was constantly grinding her teeth, and had a spasmodic affection of every part of the body. Saliva flowed continually from her mouth. 24th. She was found dead this morning, and I examined her at seven A.M.

EXAMINATION.

All the ganglia of the sympathetic nerves were inflamed, but not in the same degree as in the preceding experiment. The right superior dorsal ganglion was inflamed in a greater degree than any of the rest. The right semilunar ganglion was more inflamed than the left. There was more redness of the par vagum than in the preceding experiment. The ganglia of the fifth pair of nerves were more red than natural. The brain was healthy, but its membranes were very vascular. The spinal chord was healthy, but its pia mater was too vascular. The ganglia of the spinal nerves were not vascular. The nerves forming each axillary plexus were much more vascular than natural, but near the elbow no vessels could be distinguished. The sciatic nerves were not so vascular as those of the axillary plexus.

The inferior lobe of the right lung was purple and solid; the superior lobes had purple spots on them, but they were not solid. The left lung had purple spots on it, and its inferior lobe was the most affected, but it was not near so much diseased as the right. The liver was much darker than usual, and I supposed it was inflamed. The pancreas was much more red than natural. Neither the stomach nor small intestines had any redness on their villous coat, but the mucous coat of the rectum and bladder was very red. The stomach and intestines contained an unusual quantity of bile. There were several red spots on the inside of the cheeks, but there was not the least ulceration. The absorbent system appeared to be in a state of irritation.

EXPERIMENT IX.

February 20th, 1823, at ten A.M., nine drachms of quicksilver, by means of a bone syringe, were injected into the right jugular vein of a moderate sized dog, about six months old. Soon after he ate some meat with an appetite. At one P.M. the difficulty of breathing was very great. At nine he was much the same. 21st. He breathed with greater freedom, and appeared more lively. 22nd. He was much the same, except that he appeared weaker. 23rd. He continued in the same state. 24th. At eight A.M. he was found dead. He did not take any food, except once immediately after the operation.

EXAMINATION.

The ganglia of the sympathetic nerves were natural; or, if there was any difference, it consisted in the slightest possible redness, but the appearance was very different from that presented by the ganglia when mercurial preparations had been either taken by the mouth, or injected into the veins. There was a slight redness of the par vagum, just before it passes behind the lungs. In every other respect the nerves had a healthy appearance.

There was some bloody fluid in each cavity of the chest. The pleura was inflamed. The lungs were inflamed and quite solid, and when cut into exhibited numerous globules of quicksilver, surrounded by purulent matter. The heart was sound. The viscera of the abdomen appeared quite healthy, and there was not the least redness of the villous coat of the stomach and intestines. A small quantity of quicksilver was contained in the stomach, and at the termination of the small intestines. There was neither redness nor ulceration in the mouth.

For the purpose of ascertaining how mercury acts when rubbed on the skin, the following experiments were made:—

EXPERIMENT X.

September 12th, 1822, the hair was removed from part of the back of a common sized shepherd's dog, and one drachm of strong mercurial ointment was well rubbed on it. From this time to the 18th two drachms were used each day. From the 15th the gums began to be red; on the 17th there were ulcers on the cheeks, which increased to the 19th, on the 23rd they were healing; on the 24th they were all healed but one. On the 23rd, 24th, and 29th, one drachm of ointment was used, and from September 30th to October 31st two drachms on each of nineteen days. Her mouth was at times inflamed, and had some slight excoriations, but was never so bad as on the 17th. Her appetite was generally good to October 6th; afterwards it varied more. On the 6th there was blood in her stools, and on several other days, and the stools were often black. On the 24th food passed through the intestines unchanged three hours after it was eaten; her lower extremities became weak. On the 29th she was unwilling to move. On the 30th her stools were chiefly bloody mucus, but one was quite yellow. She has been losing her flesh for some time, and is now very much emaciated. She was hanged on the 2nd of November. She was always kept muzzled, except for a day or two about the 20th of September, and when she was fed, so that she was prevented from licking any of the ointment from the parts to which it was applied.

EXAMINATION.

This took place an hour after death. The inner surface of the skin was more red than natural. All the ganglia of the sympathetic nerves were inflamed, but the semilunar were so in the greatest degree. The par vagum was not more vascular than the other nerves. All the nerves had a slightly red appearance, and were different from those of a healthy dog in not having their usual whiteness. The brain and spinal chord were healthy, but the pia mater inclosing the latter was rather more vascular than natural; and there was a small quantity of fluid in the sheath. The ganglia of the spinal nerves were not more red than usual. There was more than the usual vascularity about the aorta. All the thoracic viscera appeared sound. All the abdominal viscera were sound, except the intestines, the villous coat of which was highly vascular throughout. The absorbent glands in the abdomen were enlarged.

EXPERIMENT XI.

March 29th, 1823, the hair was removed from part of the back of a dog of moderate size, and two drachms of strong mercurial ointment were well rubbed on it, also on the 30th and 31st. April 1st, her mouth is very much inflamed, and there are red spots on the cheeks. At 4 P.M. she is dull and unwell, and has purged twice. A piece of gold was given her in beef at this time. On the 2nd the gold had passed out, and was not in the least tarnished; she was hanged soon after six A.M., and was dissected at noon.

EXAMINATION.

The mouth had become quite pale, except in a few spots, where, in all probability, ulcers would have formed. The inner surface of the skin of the back was very vascular. The ganglia of the sympathetic nerve were in an incipient state of inflammation, which existed in the greatest degree in the superior cervical. The ganglia formed by the fifth pair of nerves were more red than natural. The brain and spinal chord and their nerves had a healthy appearance, but some of the ganglia of the spinal nerves were more red than natural. The heart was sound; the lungs were more firm than usual, and very purple, probably on account of the kind of death. The villous coat of the intestines was very vascular, and likewise the inside of the rectum. The thoracic duct was full of lymph, which was quite tasteless.

EXPERIMENT XII.

From April 1st, 1823, to the 25th, two drachms of strong mercurial ointment were rubbed on the back of a large dog every day except on the 21st. Twenty minutes were generally occupied in rubbing it in, but when his back was very sore, two or three minutes only were employed. He was kept muzzled the whole time, except when he was fed. On the 3rd his back began to be sore and his gums red. On the 5th his mouth was much inflamed, and had red spots on each side; and on the 6th there were ulcers which continued the same until the 12th, when they were rather better; on the 13th they were healing; on the 17th they were still better; on the 20th they had increased; but on the 25th were nearly well. He had a good appetite to about the 17th. On the 10th he had lost his flesh, and continued to lose it. He was generally costive, and required sulphur: there never was any blood in the stools except on the 23rd. On the 8th he had a gold ring given him in a bit of meat. On the 11th it passed out, but did not appear to have been in contact with mercury. On the 20th it was given him again, but was never parted with. He was hanged on the 25th at noon, and was dissected two hours after.

EXAMINATION.

All the ganglia of the sympathethic nerves were much inflamed, and especially the superior cervical. The brain and spinal chord and their membranes were very vascular. The ganglia of the spinal nerves and fifth pair were rather more vascular than natural. The other nerves had not any particular redness. The inner surface of the skin on which the ointment was rubbed, was very vascular. The thoracic viscera were sound. All the abdominal viscera appeared very vascular. The liver was very dark coloured. The villous coat of the stomach and small intestines were red. The inside of the rectum was more red than natural, and in the same degree as the villous coat of the small intestines. The gold ring was found in the stomach near the pylorus; it was tarnished, but not in the least affected by mercury.

Experiments similar to the two first, in which mercury was given by the mouth, are the most satisfactory, as so much time is allowed for a gradual development of the symptoms, and because it is probable that death does not produce any changes which make the appearances on dissection questionable. The introduction of mercury into the veins produces appearances which may in some degree be attributed to the excitement, as well as to a mechanical congestion of the bloodvessels, depending on an impediment to respiration arising from inflammation of the lungs. The appearances on examination, after mercurial friction, are in some degree open to the same objection, because the subjects resist the influence of the operation so long, and must be destroyed in a violent manner; and some of the appearances may be the consequences of the act of dying.

The results of these experiments lead to the conclusion, that mercury, when swallowed, first produces an irritation of the branches of the sympathetic nerve, spread on the villous coat of the intestines, which increases according to its continuance. It may, by communication secondarily, affect the nerves of the limbs; but these do not become affected in any degree like the sympathetic. In the second experiment, the par vagum, and the nerves forming each axillary and sciatic plexus, were very red from vessels near their communication with the sympathetic, and the vascularity was very evidently diminished the further they were distant from it.

It is not to be understood that the appearances presented by the two first experiments are to be found at the commencement of a gentle action of mercury; nor, indeed, always after this has continued some time. Such appearances as a moderate increase of the arterial circulation would exhibit during life, may have ceased in a considerable degree after death. Therefore, the great vascularity of the sympathetic nerves, of the cellular membrane surrounding them, and of the outside of the aorta, show the extreme state to which the irritation may reach. The eleventh experiment may probably be taken as an example of the incipient affection of the system.

The introduction of mercury into the veins, and through them into the lungs, shows that the speedy result depends upon the activity of the compound, and not on the mercury itself; for when the compound is used death takes place in a few hours, and when crude mercury is employed, the animal lives some days; after the use of the compound, there is an appearance of great existing excitement in the nervous system; but not after the employment of crude mercury, although it produces very numerous abscesses in the lungs. This result makes it probable that, when crude mercury, taken into the alimentary canal, salivates, it has previously undergone some change, either by the mechanical action of the intestines, or by some chemical process through the feculent matter.

It is probable that mercury acts on the villous coat of the stomach and intestines by producing a peculiar irritation; for it is not the quantity used, which excites salivation and other consequences, but the irritating form in which it is administered, and the peculiar condition of the body at the time. Although the most acrid produces pain and violent inflammation, it may be so diluted as to be borne almost as well as milder preparations, and affect the system in a similar manner, so that a very small quantity of the mercury itself is required for this purpose. When it has irritated the intestines, it probably passes off, it has then undergone some change; for after the use of the submuriate and crude mercury, matter resembling the grey oxide has been several times found in the stools, and in the intestines.

It is not necessary that medicines should be absorbed and received into the circulation before they affect the body; but they may produce a local excitement, capable of being conveyed by the local nerves to other portions of the nervous system, and to other organs. They may, however, act in both ways. If it be absorbed it is after its union with some of the secretions through such an assimilative process as prevents it from decomposing the blood like the oxymuriate, otherwise it would produce obstructions in the capillary vessels. If it be allowed that it is reduced to a compound capable of incorporating and circulating with the blood, and that when it has been rubbed on the skin it becomes assimilated with the lymph before it enters the absorbents, it must still be presumed that it acts on the nervous system through the nerves distributed on the coats of the arteries and other structures, by contact with the blood, and even then it must have an elective preference for the parts supplied by the sympathetic nerves.

At first sight the experiments of injecting different preparations of mercury into the veins may appear to favour the opinion that it is absorbed and received into the circulation; but the inflammation of the lungs and other violent symptoms, then invariably taking place, lead to the conclusion that the same effect must be produced after its absorption, if it resembles any of the preparations introduced into the lungs by experiments, unless they be in a very diluted form.

Mercury is a decided stimulant of the nervous system, and through this of the sanguiferous. A small quantity gently excites the salivary and absorbent organs, and promotes the functions of the viscera without any disturbance of the constitution. But when it is continued so as to affect the body generally, it produces an increased action of the heart and arteries, a furred tongue; and, according to the vigour or feebleness of the patient, irritative fever, an increase or depression of the spirits, and generally along with one or more of these symptoms, irritation in the mouth, and an increase of the saliva, urine, perspiration, bile, and other secretions, through the excitement it produces on their respective organs. When a sufficient quantity has been employed, it produces a general excitement of the sympathetic, and through this of the viscera. It probably does not affect the heart and larger arteries without a previous implication of the ganglia. In acting on the terminal nerves, it also acts on the terminal arteries. It probably first produces an increased impetus of blood into them, and causes their distension, and then excites an irritable contraction of their coats, so as again to diminish their calibre, and allow only the serosity to pass, and not coagulable lymph. It may act according to the condition of the body, or of any particular organ. If it be in full effect when a sound organ is seized with inflammation, it may tend to increase the activity of this, and favour the impetus of blood into it; but if its effect take place after a part has been some time inflamed, and the minute vessels have already attained their greatest degree of dilatation, and their activity has somewhat abated, it then favours their contraction. In this manner it may seem to exert a double or contrary influence on two organs at the same time, aggravating if not producing the inflammation in the one, and removing its consequences in the other.

Independently of its specific influence, the inflammation it excites quickly tends to ulceration: the swelling of the gums may cause the thin and firmly adherent cuticle to crack, and the cheeks may suffer from the pressure against the teeth; the action of the mouth and throat in preparing and swallowing the food may mechanically induce ulceration, and the irritating saliva may tend to aggravate it. The alimentary canal, but especially the rectum, is more or less affected, and in some instances, when all the other portions of the canal escape, the rectum is inflamed or ulcerated; it may be a question whether this be owing to the peculiarity of structure of each part, and the nerves supplying it, or whether the matters passing along it increase the irritation: the delay of blood in the rectum, from its depending position may favour the continuance of disease, as well as the expulsive action, and the presence of the acrid fæces. The affection of the sympathetic nerve may produce uneasiness in several of the organs it supplies ; that of the par vagum, anxiety and an aggravation of pulmonary symptoms. The increased vascularity of the spinal nerves may account for pains in the limbs, and sometimes for their weakness.

It sometimes brings other organs into an inordinate activity, in which there had been a tendency to disease from a previous affection, or a peculiar original structure. Therefore, notwithstanding its general influence, it may fail of relieving an organ, which, on account of its weakness, has not a sufficient control over higher actions. It probably cures when all the parts of the body have a similar original perfection of structure, and the one affected has been only exposed to an accidental exciting cause.

As mercury acts so decidedly on the sympathetic nerve, it can be readily understood how the intestines and the rest of the abdominal viscera are influenced, and the heart and arteries, and how it excites the action of the salivary glands and other parts about the mouth by means of the branches of the superior cervical ganglion, which accompany all the branches of the external carotid artery in nearly the same manner as those of the semilunar ganglion do the arteries distributed on the abdominal viscera.

When mercurial vapours are inhaled, it is probable that they affect the system through the delicate and sensitive membrane lining the throat, and some of the vapours may also be swallowed with saliva. It may be presumed that they are taken into the lungs, and become absorbed like the vapors of turpentine; but the mercury would then probably resolve itself into globules, which, if not safely entangled in the mucus, would escape into the air-cells, and produce abscesses in the lungs as in the experiments in which it was introduced through the veins.

In some persons large quantities with difficulty affect the constitution, whilst in others violent symptoms arise from a few small doses. The varied effects in different people must depend on the original structure of the body, and especially of the nervous system, and the susceptibility thence arising, as well as various contingencies at the time, from moral or other causes implicating the nervous system. Its influence on one part rather than another is connected with the peculiarity of structure of organs in different individuals, and their degree of exposure to the atmosphere or other agents. In making examinations after experiments, all the ganglia had not the same morbid appearance in the same subject, nor even the viscera.

In the experiments with mercurial friction, the mouth was always first affected; but the continued use of the ointment ceased to stimulate this, and then excited other parts. It seems, therefore, that when organs have been fully subjected to its influence, they lose much of their capability of receiving further impression from the nerves. There are, however, cases in which the reverse is remarkably exhibited, as when salivation returns from a very small quantity used, or even entirely without it, from an impression on the nervous system.

Mercury may be given in occasional large doses for evacuating the alimentary canal of offensive matters. It may be given in smaller doses for restoring to a healthy condition secreting organs. In alternative doses it has a local action on the intestines, and alters the condition of the villous coat and the secreting points, and may also, through the nerves of the intestines, affect the nerves of other organs. Small doses, if long continued, produce a considerable change in the system; and in a highly susceptible constitution may induce general excitement, and then there is very little distinction between their effect, and that of larger ones in other persons. For relieving acute inflammation of the interior of the eye-ball, the membranes of the brain or other important organs, it must be given to affect the system quickly; but it is not proper in the more active stages of acute inflammation of large surfaces until depletion has been sufficiently used.

It must be joined with opium if it irritate the lining membrane of the intestines, otherwise it may pass off before it has induced any other than a purgative action. It must be continued until the constitution is affected by some of the symptoms previously described. If immoderate doses are given, and left off, and again resumed, the effect will often prŏve disappointing; the system will have been excessively disturbed, and the disease remain uncured. Moreover, the repeated use of mercury alters the actions of the whole body, and induces other diseases; therefore, whenever the violence of the disease does not require its speedy influence, as in countervailing an animal poison, or in removing a chronic thickening of the membranes of the brain, or of any other organ, it is better to proceed cautiously with a moderate quantity of a mild preparation, until the object of its employment has been accomplished. When the first effect of its stimulus declines, it ceases to be capable of eliciting any further increased admission of blood into the terminal blood-vessels: and this may be the case with the salivary glands, for the salivation abates, and often cannot be renewed; the terminal nerves and arteries have then undergone another change, and the arteries do not again readily resume the first action which produced their dilatation. The contrary disposition may, however, be observed in some instances, when salivation returns from any slight irritation of the nervous system. Its use may be carried to such an extent as to produce a permanent dilatation from the debility following over-excitement, and this is the state preceding death, for in experiments which have terminated fatally, the outside of the aorta, and the cellular membrane surrounding the sympathetic appeared covered with enlarged vessels in a state of congestion: in some structures this condition may terminate in the mortification of the part particularly affected.

When mercury is given for countervailing acute diseases, it may prove beneficial by creating a general and new disorder, in stimulating the whole sympathetic nerve and arterial system, and thus diverting their almost undivided influence from the diseased organ. If, however, this general excitement cannot be properly supported, venous congestion, depression, and death may be the consequence. It countervails the morbid state also, by irritating the salivary glands, or intestines, or some excretory organs, and by their discharges. It also stimulates the absorbents to remove effused matter. In exciting the contraction of terminal arteries, it probably favors more the effusion of serosity than of coagulable lymph.

As when it has produced much and continued excitement in the system, it is unfavourable to the deposition of coagulable lymph, it is also to the healthy completion of abscesses, and especially by augmenting the feverish and irritable state of the system. A profuse salivation adds to the debility attending a large discharge of purulent matter. When there are tubercles having a low power, and placed in very irritable parts, as the lungs, and its excitement is incapable of promoting their absorption, it tends to determine suppuration, by irritating the part surrounding the tubercle: it may not affect the tubercle itself; this, however, now adds to the irritation, as an extraneous body. In scrofulous tumours, therefore, and all others having a low character, it will generally do harm, and especially if they have not power enough to assume or bear any increased action for ultimately promoting their absorption.

If the secretions of the chylo-poietic viscera are improper and discoloured, and mercury is given for correcting their condition, instead of this change they became daily more unhealthy, when by leaving off the mercury and giving quieting medicines if there be too much irritation, or tonic medicines if there be too much debility, they will return to their healthy state.

An ulcer will heal as soon as the secretions of the viscera have been made healthy by some moderate doses of mercury. An inactive ulcer may be disposed for healing by a local application of mercury. If it depends on the constitution, a general mercurial action will produce a change in the terminal nerves and arteries, and dispose it for healing; but in a weak or excitable person, it may soon be made irritable, when the mercury must be discontinued, and quieting or tonic medicines administered, until its use can be resumed.

Sometimes mercury acts as a poison, not on account of the large quantity used, but on account of the peculiarity of the constitution, and may produce sudden death. This state is accompanied by faintings, and a feeble irregular pulse ; and it is not improbable that the nerves of the heart are so inordinately implicated as to prevent a due action of the coronary arteries, and consequently of the ventricles. In this case its use must be entirely suspended, and the strength supported by restoratives and stimulants as often as the powers of life are in danger of failing. The body must be kept quiet, and the temperature cool.

As mercury affects the system so generally, it does not succeed in some instances. It may be proper for curing an acquired or new disease in one part, but other parts having a morbid tendency from a peculiarity of original structure, may, at the same time, be brought into inordinate or destructive action by it.

A mercurial course must be considered as a new disease, varying in its symptoms according to the state of each individual. Reason points out that the body should be guarded from exposure to wet and cold, and other external circumstances ; that its strength should be supported by the use of a mild diet if there be fever, always by as much nourishment as will prove a compensation for any large and continued discharges, and by tonics and restoratives, if the powers of the system fall too low.

It is probable that the effects of mercury are ever varying, and particularly when severe, according to the constitution, and the peculiarity of structure of some organs ; also, according to the waste it occasions, and the difficulty of replenishing the vital fluids when the mouth and throat are very sore, or the other parts of the alimentary canal very irritable. Therefore much of its benefit must depend on the ability of the constitution to bear it, and on its use at the proper time, and in such a judicious manner as will insure the power of continuing it, until it has completed its purpose.

As it appeared desirable to ascertain whether arsenic affected the nerves, the following experiments were made :—

EXPERIMENT XIII.

April 11th, 1823, at seven A.M., two grains of the sublimed oxyd of arsenic, mixed in an ounce of cold water, were injected into the left jugular vein of a large dog. He immediately breathed with difficulty, and appeared as if he would die. He soon, however, recovered from this state. Half-an-hour after he breathed again with difficulty. At four P.M. he ailed very little. At six he breathed with difficulty, and this affection was much increased by nine. 12th. His breathing is not altogether free. He is in good spirits, and has a good appetite. 13th. He appears quite well. 14th. At half-past seven A.M. four grains of the sublimed oxyd of arsenic were mixed in an ounce of hot water, and, when cold, were injected into the right jugular vein. He very soon after vomited. At ten he breathed with difficulty, and appeared much exhausted. He vomited and purged several times. He died at twelve at noon.

EXAMINATION.

The ganglia of the sympathetic nerves had increased vascularity. There was not any decided deviation from the healthy appearance in the other nerves. The brain and the ganglia formed by the fifth pair of nerves were more vascular than natural. The lungs, more especially on the right side, were purple, and much inflamed. There was some fluid in each cavity of the chest. There was not any appearance of disease in the heart. The villous coat of the stomach was red; that of the small intestines, especially at its superior part, was very highly inflamed. The inside of the rectum was much more red than natural.

EXPERIMENT XIV.

April 15th, 1823, at seven A.M., some sublimed oxyd of arsenic in powder was introduced into a wound on the back of a dog. Before nine he had vomited a quantity of mucus. He died at one P.M.

EXAMINATION.

The ganglia of the sympathetic nerves was inflamed, more so than in the last experiment. The par vagum, where it communicates with the superior cervical ganglion of the sympathetic nerve, was inflamed. The brain and spinal chord, and their membranes, were vascular. The ganglia of the spinal nerves were too vascular. The axillary plexus of nerves was much more vascular than natural, but this was not the case with the sciatic nerves. The heart was not affected. The lungs were a little inflamed, but by no means equally so as in the preceding experiment, and there were some purple spots on that of the left side. The villous coat of the stomach was inflamed, but not near so much so as the superior part of the small intestines, which was red in the greatest degree, and ulcerated in several places. The remaining portion of the villous coat of the small intestines, and the inside of the rectum, were inflamed. Inflammation appeared to extend over all the rest of the abdominal viscera.

On examining the semilunar ganglia taken from a man who seemed to have died of some chronic disease, the vascularity was so very remarkable that further inquiry was made, when it was found that arsenic had been applied to a disease of the rectum.

As several acrid medicines produce an increased vascularity of the sympathetic nerve, it must be concluded that each medicine, through its inherent peculiarities, has a specific effect on the nerves in conjunction with the parts they supply, independently of any ordinary exciting quality of each, in a manner somewhat similar to that in which different substances affect the nerves of the tongue in the same degree with respect to feeling, but in different degrees with respect to tasting. Thus, both mercury and arsenic may act upon the sympathetic nerve, and produce similar appearances in it and in the viscera, if sufficient quantities of each are introduced into the system in a given time for exciting an equally powerful action. But besides these visible effects, each may exert a peculiar one through the diffusive nervous influence, whether it take place through immediate contact of the poison with the nerves, or through the juices of the body impregnated by the absorbed poison.

Various agents affect the nervous system in different ways; when the viscera are excited by them, the first impulse is on the terminal nerves, but some things act principally on the diffusive nervous influence; others act on the nervous fabrick itself; some things act on one nervous texture rather than on another, and the effect may be further modified by the structures with which the nerve becomes intermixed in different organs.

THE END.

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